3D image acquisition and reconstruction explained with online animations

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AAPM ANNUAL CONFERENCE 2016

University of Colorado
Anschutz Medical Campus

Introduction

- 3D image reconstruction is
  - A fundamental aspect of clinical imaging
  - One of first aspects introduced to those interested in learning about the field
    - Physicists
    - Physicians
    - Technologist
    - Patients
    - Young students
  - Provides a great example of how math and physics support clinically useful technology

Introduction

- Fundamental principle of image reconstruction:

  When you have 2D projection images of an object from many different angles, you can use mathematical strategies to reconstruct a 3D image of the object

Most people comfortably understand 2D imaging

+

Math

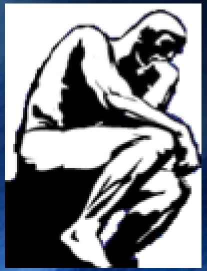
=

3D image

- *3D imaging 1 step beyond obvious for most*
  - *Ideal starting point for introducing the field*

Introduction

- For 50+ years, image reconstruction has been taught using 2D media (textbooks, lectues, text)
- Tomographic imaging acquisition and reconstruction are sequential processes
  - Particularly lends itself to explanation with animations
- Modern computing power easily supports animations
  - gif images easy to create
  - gif images are robustly displayed with internet browsers
  - animations can be shared over the internet
  - Freely and globally accessible



Someone should create animations for the community

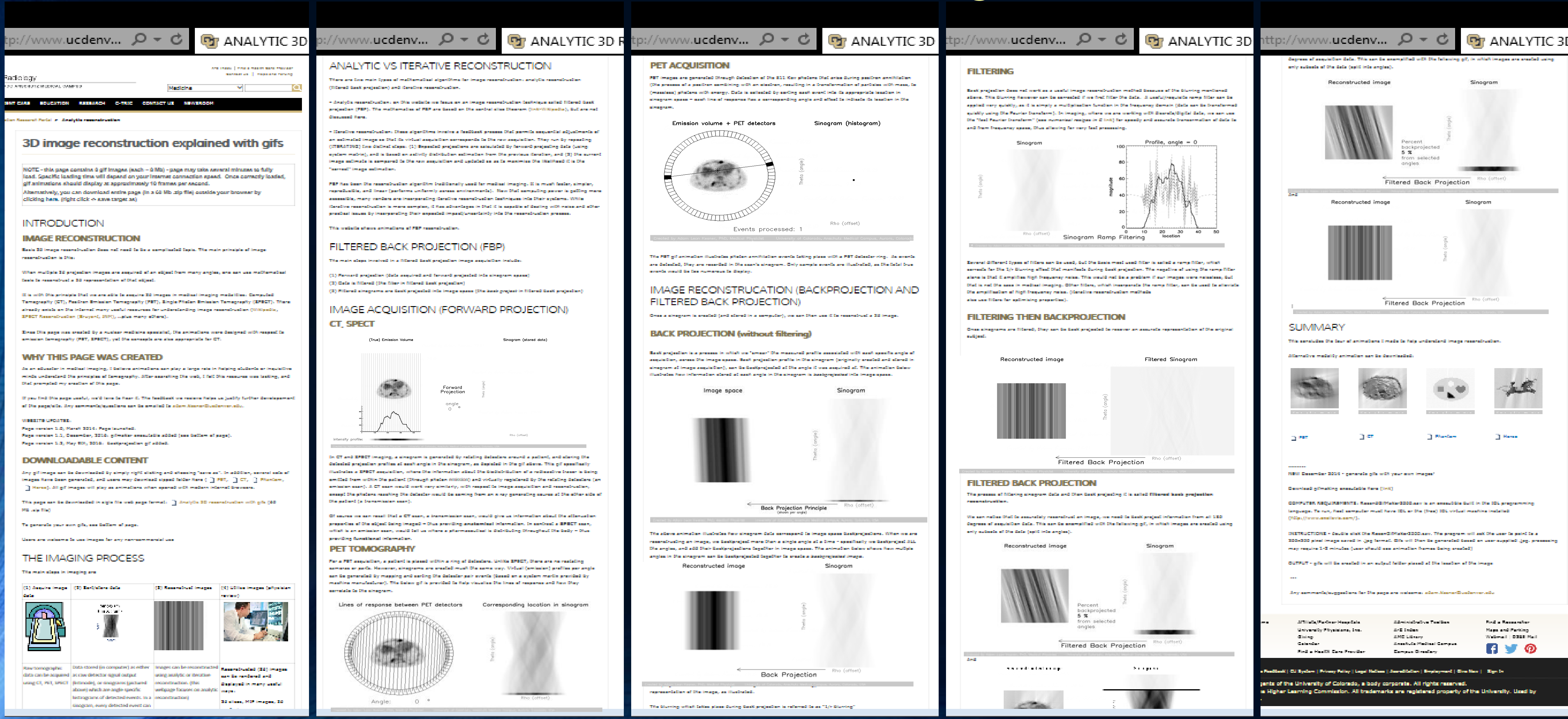
I'm someone

3D image reconstruction explained with gifs

University of Colorado Website

Google:

image reconstruction animation



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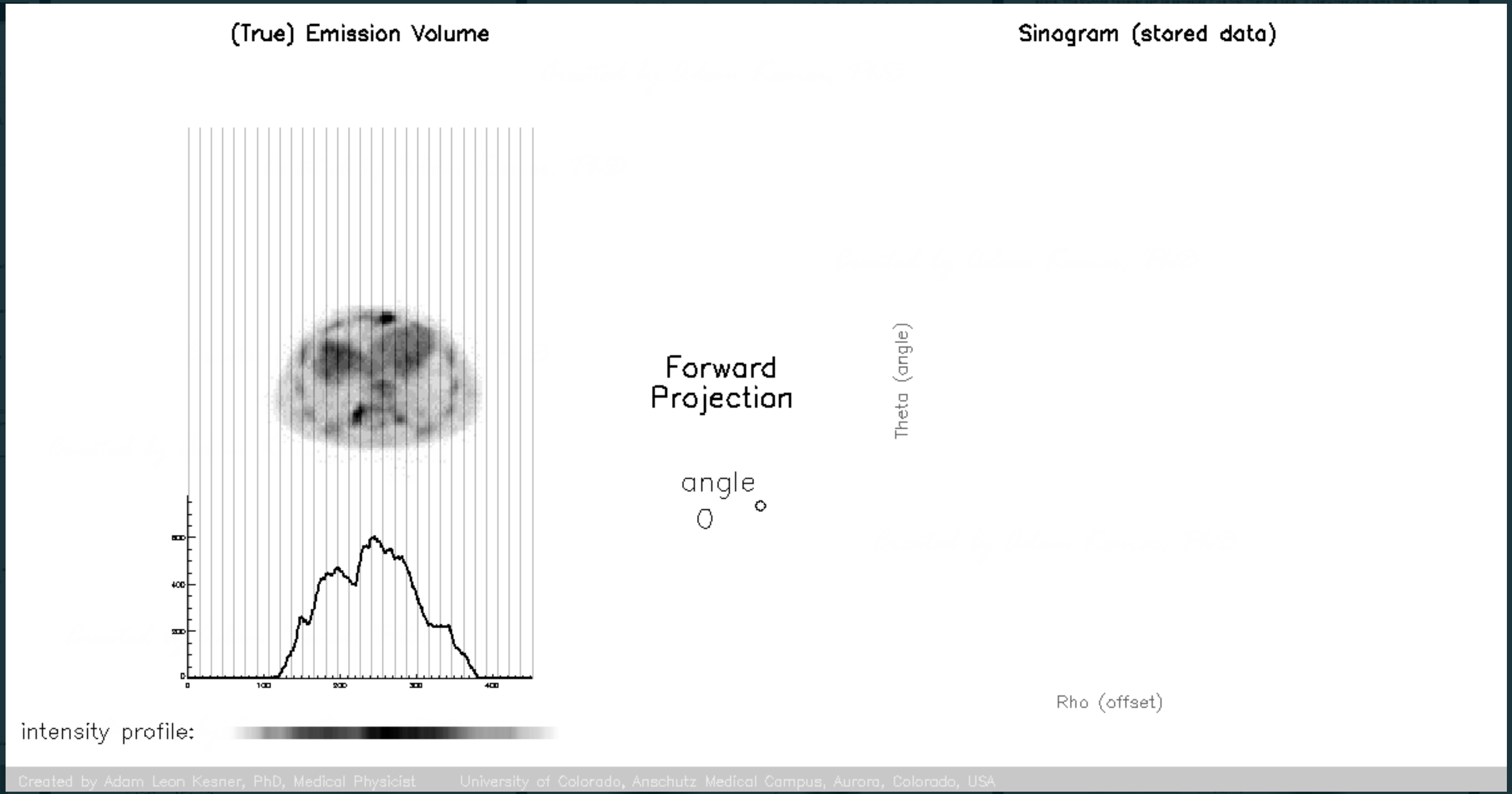

gif example 1/3

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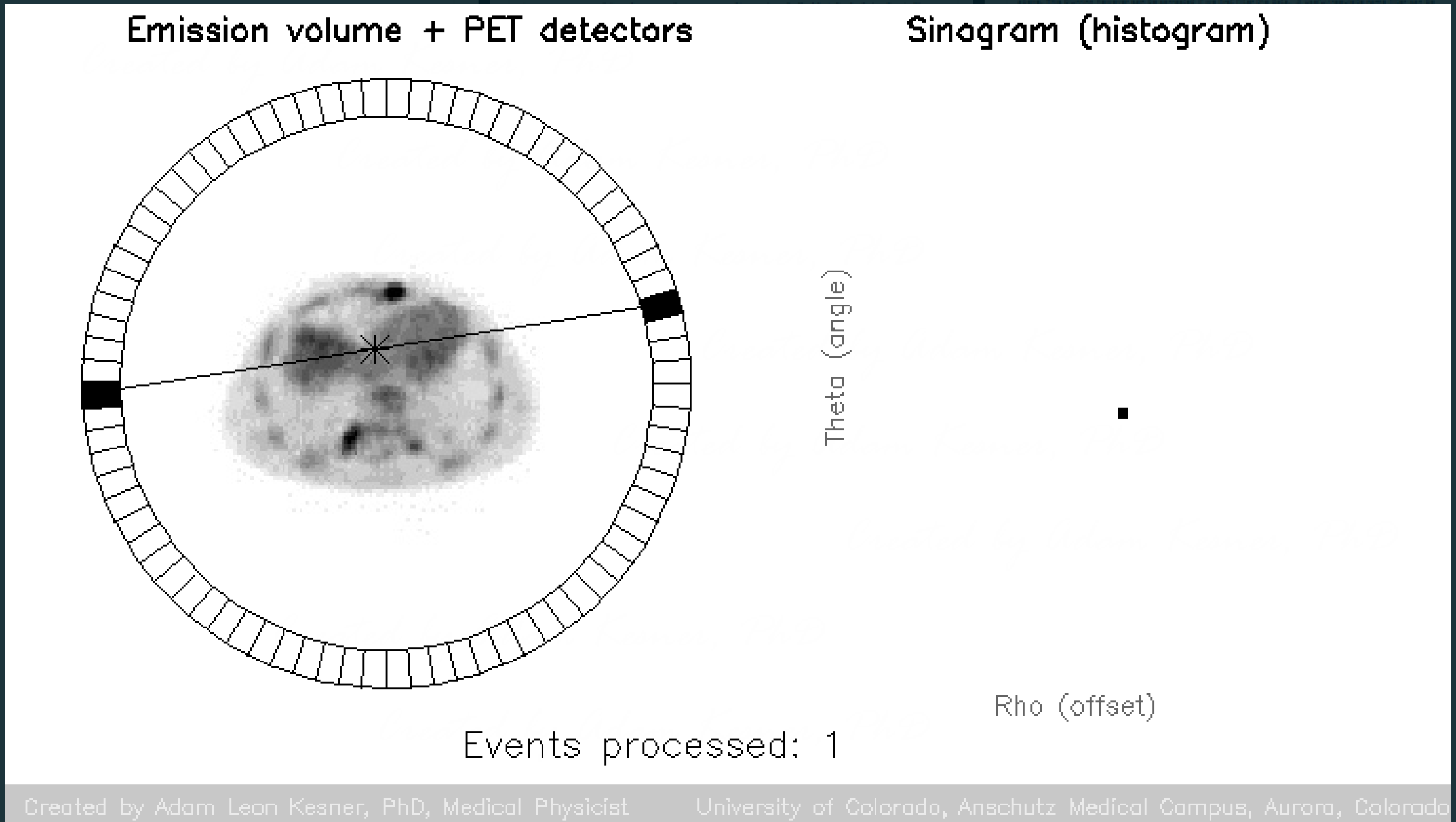
image reconstruction animation



gif example 2/3

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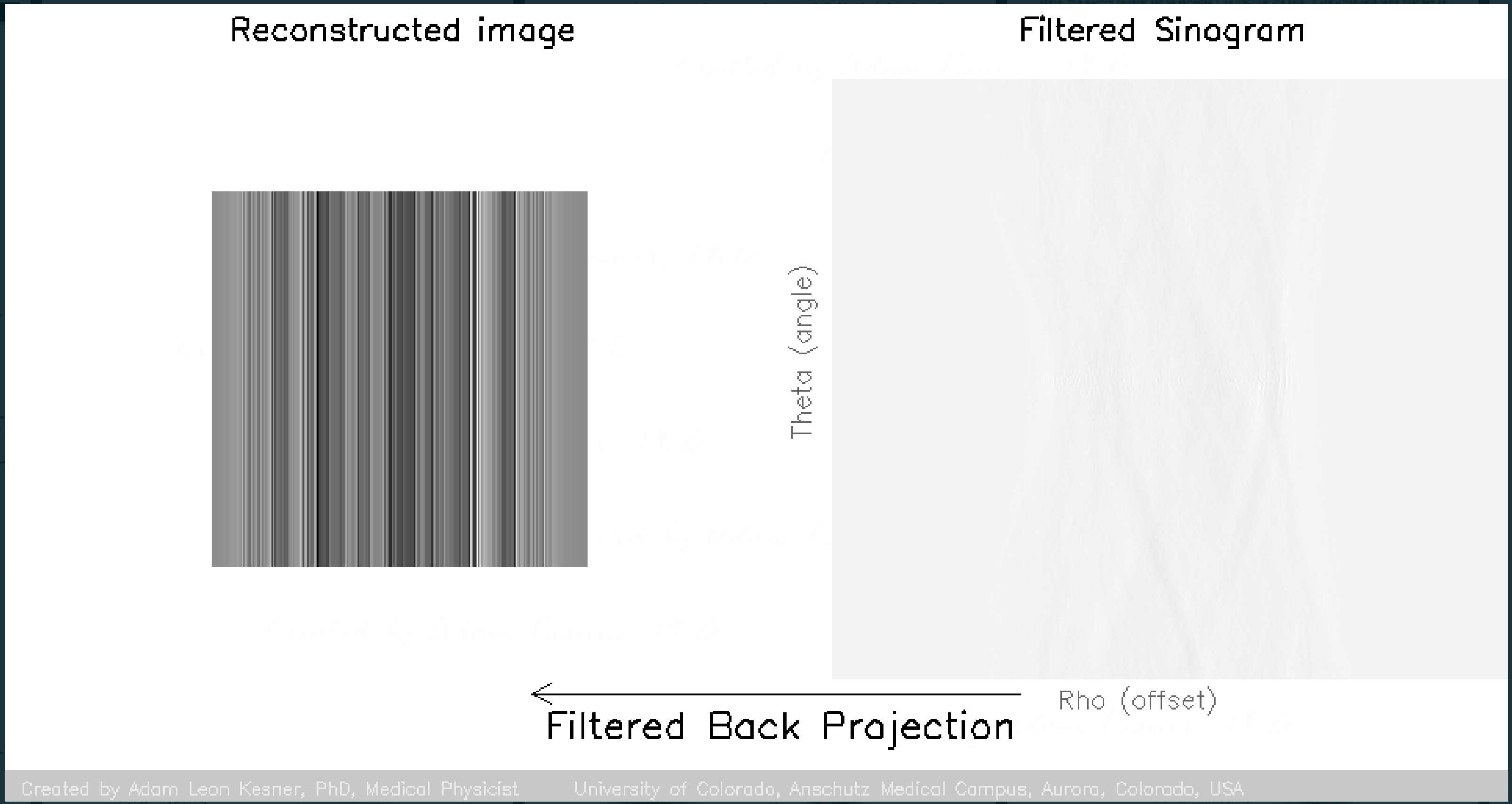
image reconstruction animation



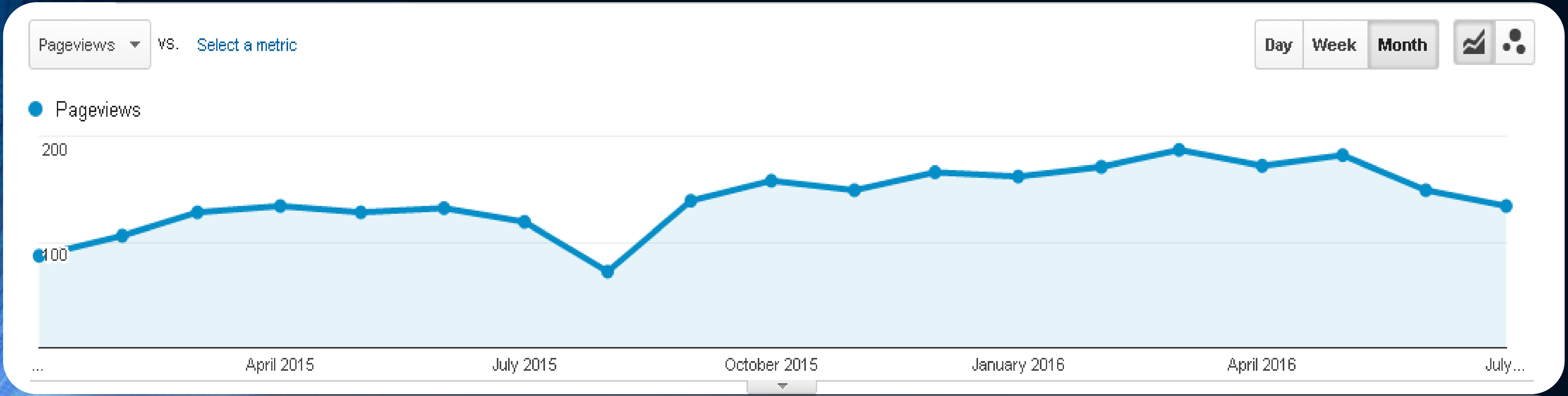
gif example 3/3

Website

- Tutorial text and animations have been posted online
  - Simple web page format
- Freely available to view or download
  - Global access
- Animations presented with focus on nuclear medicine/PET
  - Emission, transmission (CT) animations are also available
- Mirror website hosted on the IAEA Human Health Campus

Website access

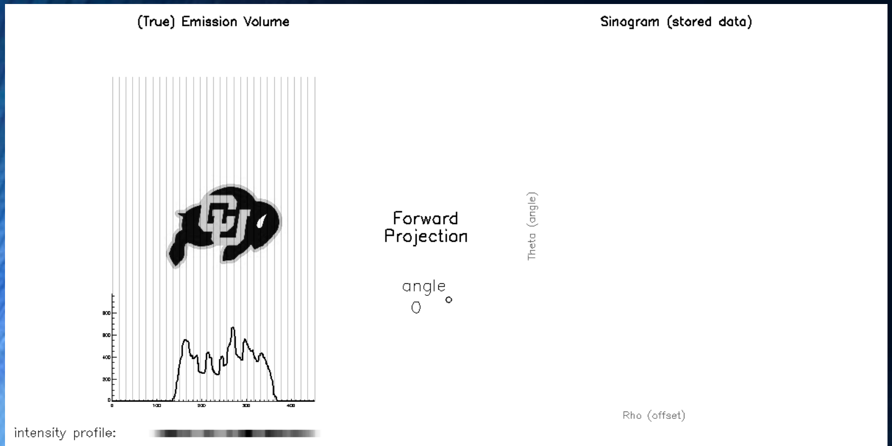
- Top google hit for “image reconstruction animations”
- Accessed from 50+ countries

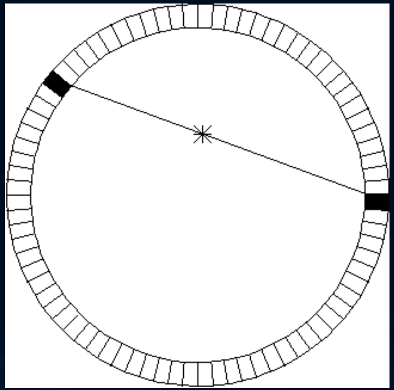


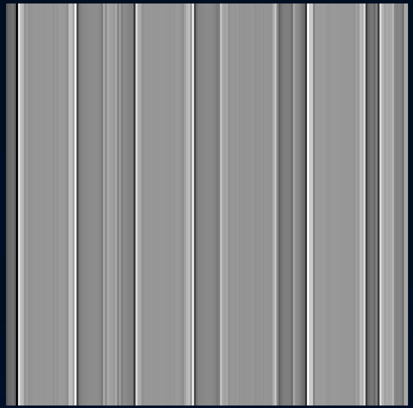
2016 - Interactive tool added to site

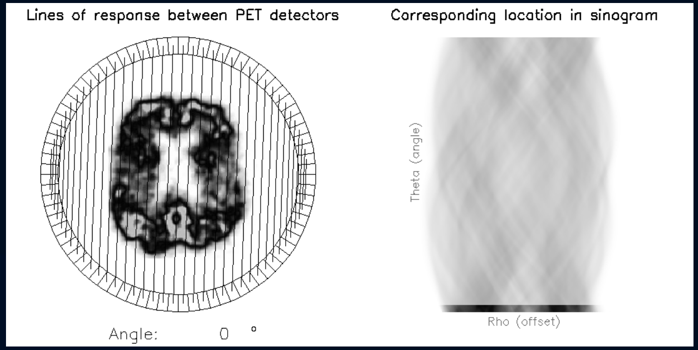
- December 2015 – interactive tool added to allow users to create their own reconstruction animations
  - Written in IDL, can be run with free virtual machine

Recon gif maker 3000





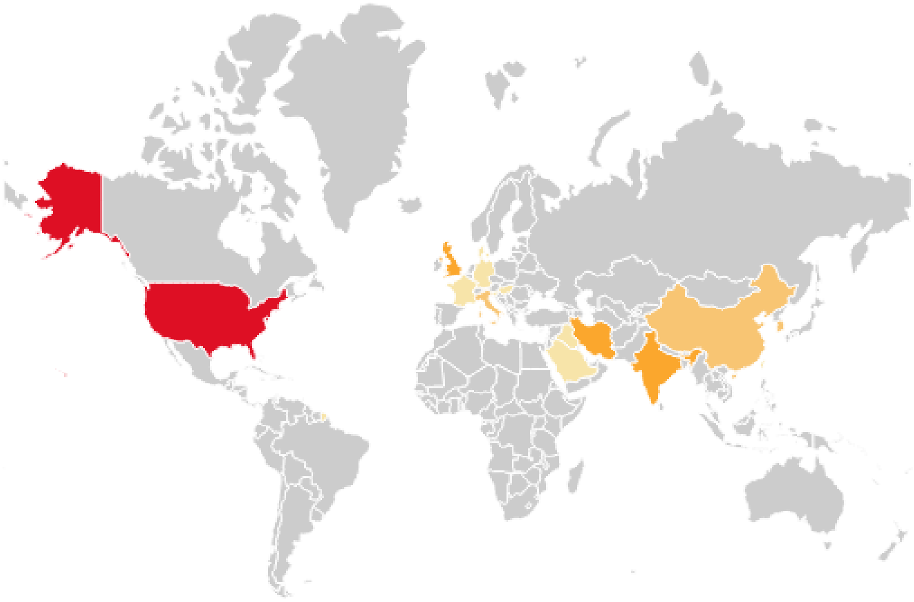




Interactive tool

- Downloaded approximately 60 times

GEOGRAPHIC DISTRIBUTION OF CLICKS



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United States	23	49%
United Kingdom	4	9%
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Iran, Islamic Repu...	3	6%
Korea, Republic of	2	4%
Italy	2	4%
China	2	4%
France	1	2%
Denmark	1	2%
Saudi Arabia	1	2%
Slovenia	1	2%
Hungary	1	2%
Taiwan	1	2%
Iraq	1	2%
Germany	1	2%

Show less

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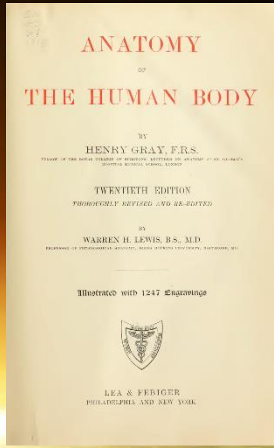
Summary

- Identified a need for improved teaching tools to help visualize the (temporally variant) concepts of image reconstruction
- gif animations can be a useful tool for this aspect of education
  - Robust file format
- Disseminating material freely on the web appears to be a good way to maximize their impact in the community
  - Images can be downloaded and included in powerpoint lectures
- Positive feedback has been collected from users
- Practical way to move modern medical physics education beyond textbooks
- Increase visibility of medical physics/medical physics educational innovation in the community

Future directions

- Grant money to support:
  - Full animated reconstruction course (including iterative reconstruction)

1858
Henry Grey



ANATOMY

OF

THE HUMAN BODY

BY

HENRY GRAY, F.R.S.

TWENTIETH EDITION

THOROUGHLY REVISED AND RE-EDITED

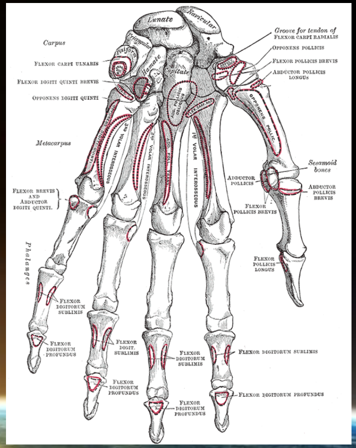
BY

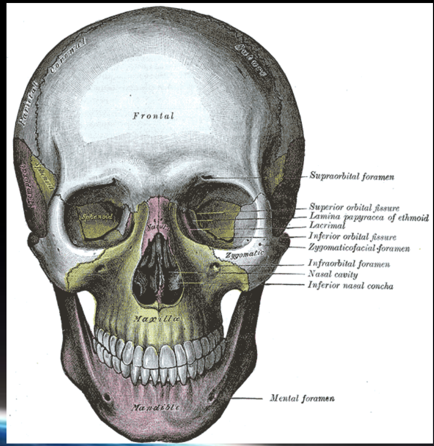
WARREN H. LEWIS, B.S., M.D.

Illustrated with 1247 Engravings

LEA & FEBIGER

PHILADELPHIA AND NEW YORK





- <u>Maybe it's time for 21st century **animated** medical physics standard book</u>